Research Proposal for PhD Programme

Tamanna Mallick

PhD student

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Department of Chemistry, Siksha-Bhavana, Visva-Bharati

Santiniketan-731235, WB, INDIA

PhD Thesis Title:

Naturally occurring bioactive compounds and their synthetic analogs: A detailed study on their spectroscopic behaviour and applications in the synthesis of fluorescent nanomaterials

Name of the Supervisor: Dr. Naznin Ara Begum

Every cell of our body is a tiny chemical factory where lots of chemical reactions are going on in a ceaseless manner. So from the view point of a chemist, it is really interesting to know how the chemical entities regulate our life processes.

The oxidative stress plays a causative role in the age-associated diseases such as cardiovascular and cerebrovascular diseases, some forms of cancer and Parkinson's and Alzheimer's diseases [1-2]. Antioxidants primarily reduce this oxidative stress. These antioxidants are of two types e.g. some of these types of compounds are produced in the living cells itself which are the integrated part of body's own endogenous defense systems. The examples of these endogenous antioxidant biomolecules are various enzymes such as superoxide dismutase, catalase and glutathione peroxidase plus vitamin E, uric acid and serum albumins. Besides the endogenous antioxidants, consumption of exogenous antioxidants or dietary antioxidants is also important [2]. Because when excess of ROS are produced in the cells, they can overwhelm the protective

effects of the endogenous antioxidant biomolecules by oxidizing membrane lipids, cellular proteins and DNA. Among dietary antioxidants (i.e. antioxidants obtained from dietary supplements), polyhydroxy flavonoids play major role besides, ascorbate, tocopherols and carotenoids.

Polyhydroxy flavonoids represent one of the most diverse and widely spread group of plant derived natural products (natural pigments), which are taken as dietary supplements [1-2]. Moreover, this type of compounds can also be synthesized in the laboratory using simple synthetic methods and easy laboratory set-up. These compounds have wide spectrum of biological and pharmacological applications as cardio protective, chemo protective antimicrobial, antiviral, anti-allergic, hepato-protective and anticancer agents [1-3]. It is believed that most of these bioactivities of flavonoid type compounds may be originated due to their behaviors as antioxidants [1-2]. Moreover, the antioxidant activities of these types of compounds are on an intimate terms with their polyphenolic structures [1-3].

During literature survey, I have found that these compounds being natural pigments, in most of the cases show strong chromophore/fluorophore like behavior [4-5]. So by using spectroscopic techniques, we can study their interactions with biomacromolecules like proteins and DNA [6-7]. This made me interested to conduct a systematic study on the antioxidant as well as DNA/protein binding activity of these compounds along with their synthetic analogues using various chemical (*in-vitro)* methods and spectroscopic techniques. Studies on the correlation between their structures, antioxidant activity and binding affinity towards biomacromolecules will help us to understand their mechanism of action and will also facilitate to find out lead structure(s) having ability to fight against oxidative stress related degenerative diseases.

I am also interested to explore the antioxidant (i.e. reducing) activity of these naturally occurring fluorophores and their synthetic analogues in the synthesis of biocompatible and fluorescent metal nanoparticles which can be used as biomarker in medical diagnostics.

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